

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: October 7, 2020

TO: Lisa Creegan – SER

FROM: Wade Strickland – WY/3

Diane Sigil for US

SUBJECT: Water Quality-Based Effluent Limitations for the Sheboygan Wastewater Treatment Plant
WPDES Permit No. WI-0025411-10
FIN: 6108

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using Chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Sheboygan Wastewater Treatment Plant in Sheboygan County. This municipal wastewater treatment facility (WWTF) discharges to Lake Michigan in the Great Lakes Basin. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 001:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
CBOD ₅			40 mg/L	25 mg/L		1
TSS			45 mg/L	30 mg/L		1
pH	9.0 s.u.	6.0 s.u.				1
Ammonia Nitrogen Nov – April	23 mg/L		23 mg/L	23 mg/L		2,3
Bacteria						4
Interim Limit Fecal Coliform				400 #/100 mL geometric mean		
Final Limit <i>E. coli</i>				126 #/100 mL geometric mean		
Chlorine	38 µg/L		38 µg/L	38 µg/L		2
Phosphorus				0.9 mg/L	0.6 mg/L	5
Arsenic						6
Mercury						6
Nitrite + Nitrate						6,7
Nitrogen, Total Kjeldahl						6,7
Total Nitrogen						6,7
Acute WET						8,9
Chronic WET				11 TUc		8,9

Footnotes:

1. No changes from the current permit
2. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7) are included in bold.
3. Monitoring only May – October.
4. Bacteria limits apply year-round. The fecal coliform interim limit will apply until the end of the compliance schedule when *E. coli* limits take effect. The *E. coli* limit applies May – September.

The *E. coli* limit may apply November – April, or the current fecal coliform limit may apply October – April instead. Additional final limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.


5. The six-month average limit of 0.6 mg/L for phosphorus is based on the best readily available phosphorus removal technology per NR 217.13(4).
6. Monitoring only.
7. As recommended in the Department's October 1, 2019 Guidance for Total Nitrogen Monitoring in Wastewater Permits, quarterly total nitrogen (total kjeldahl nitrogen and nitrate/nitrite) monitoring is recommended for all municipal major permittees. Total Nitrogen is the sum of nitrate (NO₃), nitrite (NO₂), and total kjeldahl nitrogen (all expressed as N).
8. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge and should continue after the permit expiration date (until the permit is reissued).
9. 1x yearly and acute and 1x yearly chronic WET tests are recommended. The Instream Waste Concentration (IWC) to assess chronic test results is 9%. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), chronic testing shall be performed using a dilution series of 100%, 30%, 10%, 3% & 1% and the dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from Lake Michigan.

Continued monitoring for total recoverable cadmium, chromium, copper, lead, nickel and zinc is also required because Sheboygan operates a local pretreatment program for the industries that discharge to the treatment facility.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Nicole Krueger at Nicole.Krueger@wisconsin.gov or Diane Figiel at Diane.Figiel@wisconsin.gov.

Attachments (3) – Narrative, Outfall Map, & Thermal Table

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Attachment #1
**Water Quality-Based Effluent Limitations for
Sheboygan Wastewater Treatment Plant**

WPDES Permit No. WI-0025411-10

Prepared by: Nicole Krueger

PART 1 – BACKGROUND INFORMATION

Facility Description: The City of Sheboygan operates a conventional activated sludge wastewater treatment facility with an 18.39 MGD annual average design flow. The WPDES permit application indicates the treatment facility services a population of approximately 70,000 people and 15 categorical industrial contributors. Raw wastewater enters the plant and passes through fine screens and a Pista grit removal system before flowing to four primary clarifiers. Screenings material and grit are hauled to a licensed landfill. From the clarifiers, the supernatant is then sent to two basins for Biological Phosphorus Removal. If needed, further phosphorus removal is accomplished with ferric chloride. Treatment is continued in four aeration basins followed by four final clarifiers. Wastewater is then disinfected with sodium hypochlorite in the contact chamber and then de-chlorinated with sodium bisulfite before discharge to Lake Michigan. Sludge is anaerobically digested in three digesters and gravity belt thickened. Approximately half of the liquid biosolids are further processed through dewatering by a screw press. The dewatered sludge is then dried to produce a Class A, exceptional quality “EQ” product. The City of Sheboygan contracts with Sure Gro, LLC to properly transport, store and distribute the EQ biosolids with the exception of those retained by the City of Sheboygan. Liquid biosolids and Class B cake sludge is land applied on to Department approve agricultural fields. The Department has found the facility to be in substantial compliance with the current permit.

Attachment #2 is a map of the area showing the approximate location of Outfall 001.

Existing Permit Limitations: The current permit, expiring on 12/31/2020, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
CBOD ₅			40 mg/L	25 mg/L	1
TSS			45 mg/L	30 mg/L	1
pH	9.0 s.u.	6.0 s.u.			1
Ammonia Nitrogen November – April	23 mg/L				2
Phosphorus				0.9 mg/L	3
Fecal Coliform Year round				400#/100 mL geometric mean	
Chlorine	38 µg/L				
Mercury	2.8 ng/L				
Arsenic					4
Cadmium					4
Chromium					4
Copper					4

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Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Lead					4
Nickel					4
Zinc					4
Acute WET					5
Chronic WET					5

Footnotes:

1. These limitations are not being evaluated as part of this review. Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
2. Ammonia – The daily maximum limit of 23 mg/L applies November 1 – April 30. Monitoring applies May 1 – October 31.
3. This is an interim limit. The final limits are pending the development of a whole lake model.
4. Monitoring only.
5. Acute and chronic WET tests are required 1x yearly. The instream waste concentration for chronic tests is 9%.

Receiving Water Information:

- Name: Lake Michigan
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Cold water fish community, public water supply.
- Flow: A ten-to-one dilution ratio will be used for calculating effluent limitations based on chronic or long-term impacts, in accordance with s. NR 106.06(4)(b)2, Wis. Adm. Code, because the receiving water does not exhibit a unidirectional flow at the point of discharge.
- Hardness = 140 mg/L as CaCO₃. This value represents the geometric mean of data from chronic WET tests from 05/20/2014 to 10/08/2019.
- % of low flow used to calculate limits in accordance with s. NR 106.06 (4) (c) 5., Wis. Adm. Code: 25%
- Source of background concentration data: Metals data from Lake Michigan is used for this evaluation from the Water Quality Rules Implementation Plan (1998). Background mercury data is from the EPA *Results of the Lake Michigan Mass Balance Study: Mercury Data Report* (2004). The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen are described later.
- Multiple dischargers: There are several other dischargers to Lake Michigan however they are not in the immediate vicinity and the mixing zones do not overlap. Therefore, the other dischargers do not impact this evaluation.
- Impaired water status: Lake Michigan is 303d listed as impaired for PCBs.

Effluent Information:

- Design Flow Rate(s):
Annual average = 18.39 MGD (Million Gallons per Day)
For reference, the actual average flow from 01/01/2016 to 04/30/2020 was 11.47 MGD.
- Hardness = 302 mg/L as CaCO₃. This value represents the geometric mean of data from 11/05/2019 to 11/14/2019 in the permit reissuance application.

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- Acute dilution factor used in accordance with s. NR 106.06 (3) (c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Water Source: About 12.49 MGD is from Lake Michigan and 0.36 MGD is from groundwater. There are 8 industrial contributors: 3 Sheeps Brewery, Three Twins Ice Cream, 2 Old Wisconsin Sausages, Old World Creamery, Gibbsville Cheese, MilliporeSigma, and Rockline Industries.
- Additives: Ferric chloride is added for phosphorus removal. Sodium hypochlorite is added for disinfection and sodium bisulfite is added for dechlorination.
- Effluent characterization: This facility is categorized as a major municipal, so the permit application required effluent sample analyses for all the “priority pollutants” except for the Dioxins and Furans as specified in s. NR 200.065, Table 1, Wis. Adm. Code. The permit-required monitoring for As, Cd, Cr, Cu, Pb, Ni, Hg and Zn from January 1, 2016 to April 30, 2020 is used in this evaluation.

	Mercury ng/L		Arsenic µg/L
1-day P ₉₉	1.3	1-day P ₉₉	1.3
4-day P ₉₉	1.0	4-day P ₉₉	0.9
30-day P ₉₉	0.88	30-day P ₉₉	0.62
Mean	0.80	Mean*	0.46
Std	0.18	Std	0.25
Sample size	52	Sample size	17
Range	0.53 – 1.2	Range	<0.28 – 1.1
	Cadmium µg/L**		Chromium µg/L
1-day P ₉₉		1-day P ₉₉	3.4
4-day P ₉₉		4-day P ₉₉	1.7
30-day P ₉₉		30-day P ₉₉	0.68
Mean*	0.09	Mean	0.46
Std	0.03	Std	0.57
Sample size	52	Sample size	52
Range	<0.14 – 0.24	Range	<0.67 – 4.8
	Copper µg/L		Lead µg/L**
1-day P ₉₉	11.1	1-day P ₉₉	
4-day P ₉₉	8.0	4-day P ₉₉	
30-day P ₉₉	6.35	30-day P ₉₉	
Mean	5.54	Mean*	1.57
Std	1.81	Std	1.39
Sample size	52	Sample size	52
Range	2.1 – 12	Range	<1.4 – 4.3
	Nickel µg/L		Zinc µg/L
1-day P ₉₉	15.3	1-day P ₉₉	33.3
4-day P ₉₉	9.1	4-day P ₉₉	25.9
30-day P ₉₉	5.51	30-day P ₉₉	20.99
Mean*	3.81	Mean	18.25
Std	2.98	Std	5.28
Sample size	52	Sample size	52
Range	<1.1 – 22	Range	<5 – 34

*Results below the level of detection (LOD) were included as zeroes in calculation of mean.

**There were only 4 detects for cadmium and 3 detects for lead so the P₉₉'s could not be calculated.

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	Chloride mg/L
11/05/2019	180
11/08/2019	210
11/11/2019	180
11/14/2019	200
Average	193

Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2 below, in the column titled “MEAN EFFL. CONC.”.

The following table presents the average concentrations and loadings at Outfall 001 from 01/01/2016 to 04/30/2020 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6):

	Average Measurement
CBOD ₅	1.94 mg/L*
TSS	3.56 mg/L*
pH field	7.14 s.u.
Phosphorus	0.47 mg/L
Ammonia Nitrogen	1.56 mg/L*
Fecal Coliform	80.21 #/100mL

*Results below the level of detection (LOD) were included as zeroes in calculation of average.

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99th percentile (or P₉₉) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Acute Limits based on 1-Q₁₀

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Adm. Code (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q₁₀ receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards.

$$\text{Limitation} = \frac{(\text{WQC}) (Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)}{Q_e}$$

Where:

WQC = Acute toxicity criterion or secondary acute value according to ch. NR 105

Qs = average minimum 1-day flow which occurs once in 10 years (1-day Q₁₀)

if the 1-day Q₁₀ flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q₁₀).

Qe = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

Cs = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e), Wis. Adm. Code.

If the receiving water is effluent dominated under low stream flow conditions, the 1-Q₁₀ method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for Sheboygan and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated water quality-based effluent limitations for this discharge along with the results of effluent sampling for all the detected substances. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L) and mercury (ng/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

SUBSTANCE	REF. HARD.* mg/L	ATC	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P ₉₉	1-day MAX. CONC.
Chlorine		19.0	38.1	7.61	<100		
Arsenic		340	680			1.3	1.1
Cadmium	302	15.5	31.0	6.2	0.09		0.24
Chromium	301	4446	8892			3.4	4.8
Copper	302	44.0	88.1			11.1	12
Lead	302	311	622	124	1.57		4.3
Mercury		830	830			1.3	1.2
Nickel	268	1080	2161			15.3	22
Zinc	302	316	633			33.3	34
Chloride (mg/L)		757	1514	303	302		210

* The indicated hardness may differ from the effluent hardness because the effluent hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the acute criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

* * The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q₁₀ flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)

RECEIVING WATER FLOW = 10:1 dilution

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P ₉₉
Chlorine		7.28		80.08	16.02	<100	
Arsenic		148.0	1.34	1615			0.9

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SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK- GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P ₉₉
Cadmium	140	3.21	0.01	35.23	7.0	0.09	
Chromium	140	113.56	0.49	1244			1.7
Copper	140	13.80	0.44	147.4			8.0
Lead	140	38.76	0.05	425.8	85.2	1.57	
Mercury		440	0.33	440			1.0
Nickel	140	69.38		763			9.1
Zinc	140	161.56	0.39	1773			25.9
Chloride (mg/L)		395		4345	869	302	

* The indicated hardness may differ from the receiving water hardness because the receiving water hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the chronic criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

Monthly Average Limits based on Wildlife Criteria (WC)

RECEIVING WATER FLOW = 10:1 dilution

SUBSTANCE	WC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P ₉₉
Mercury (ng/L)	1.3	0.33	1.3			0.88

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 10:1 dilution

SUBSTANCE	HTC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P ₉₉
Antimony	5.6		62	12.3	1.30	
Cadmium	4.4	0.01	48	9.7	0.09	
Chromium (+3)	100	0.49	1095			0.68
Lead	10	0.05	109	21.9	1.57	
Nickel	100		1100			5.51

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 10:1 dilution

SUBSTANCE	HCC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P ₉₉
Arsenic	0.2	1.34	0.2			0.62
Chloroform	53		583	117	2.70	
2,4,6-Trichlorophenol	24		264	53	2.0	

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8), Wis. Adm. Code, requires the evaluation of the cumulative cancer risk. Because no effluent limits are needed based on HCC, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

Conclusions and Recommendations: Based on a comparison of the effluent data and calculated effluent limitations, effluent limitations are required for chlorine.

Total Residual Chlorine – Because chlorine is added as a disinfectant, effluent limitations are recommended to assure proper operation of the de-chlorination system. Section NR 210.06(2)(b), Wis. Adm. Code, states, “When chlorine is used for disinfection, the daily maximum total residual chlorine concentration of the discharge may not exceed 0.10 mg/L.” Because the WQBELs are more restrictive, they are recommended instead. Specifically, a daily maximum limit of 38 µg/L (38.06, rounded to two significant figures) is required. Due to revisions to s. NR 106.07(2), Wis. Adm. Code, mass limitations are no longer required. Additional limits are discussed in the expression of limits section of this memo.

Arsenic – The current permit requires influent and effluent monitoring of arsenic. Below is the table to summarize the influent and effluent data.

	Influent Arsenic µg/L	Effluent Arsenic µg/L
1-day P ₉₉	3.4	1.3
4-day P ₉₉	2.3	0.9
30-day P ₉₉	1.7	0.62
Mean*	1.4	0.48
Std	0.60	0.25
Sample size	17	17
Range	0.76 – 3	<0.28 – 1.1

It is noted that the influent concentrations are greater than the effluent concentrations. The 30-day P₉₉ for arsenic during the permit term is 0.62 µg/L which is greater than the calculated monthly limit of 0.2 µg/L. Section NR 106.06(6), Wis. Adm. Code, allows a facility to demonstrate that a pollutant present in intake water, which is passed through the facility and discharged does not cause, have the reasonable potential to cause, or contribute to the excursion of water quality criteria in the receiving water. The demonstration has five conditions, all of which must be met:

1. The permittee withdraws 100 percent of its intake water containing the substance from the same body of water into which the discharge is made;
2. The permittee does not contribute any additional mass of the substance to the wastewater;
3. The permittee does not alter the substance chemically or physically in a manner that would cause adverse water quality impacts to occur that would not occur if the pollutants were left in-stream;
4. The permittee does not increase the concentration at the edge of the mixing zone, or at the point of discharge if a mixing zone is not allowed, as compared to the concentration in the intake water, unless the increased concentration does not cause or contribute to an excursion above an applicable water quality standard; and
5. The timing and location of the discharge would not cause adverse water quality impacts to occur that would not occur if the identified intake pollutant were left instream.

It is estimated that about 5% of the source water comes from private wells on an average basis from the Town of Wilson, the Town of Sheboygan, and from Aldrich Chemical. After discussion with Department hydrogeologists, these wells are hydrologically connected to Lake Michigan, so the source water and receiving water are therefore considered the same waterbody per s. NR 106.03(11m) Wis. Adm. Code.

Because Sheboygan discharges within the Great Lakes system and meets the conditions stated prior, there is no reasonable potential for the current discharge to cause or contribute to exceedances above the water quality criteria for arsenic. Therefore, **an arsenic limit is not recommended. Influent and effluent monitoring is required to continue in the reissued permit.**

Mercury – The WQBEL for total recoverable mercury is set equal to the most stringent criterion of 1.3 ng/L, according to s. NR 106.06 (6), Wis. Adm. Code, because the background concentration in the receiving water and similar inland streams is known to exceed 1.3 ng/L.

The current permit requires monthly monitoring of the influent and effluent for total recoverable mercury. There is currently a daily maximum limit of 2.8 ng/L which was recommended because Sheboygan had requested an exemption to the proposed mixing zone phase out during the previous permit reissuance. A total of 52 effluent sampling results are available from 01/04/2016 to 04/07/2020 for total recoverable mercury. The average concentration was 0.80 ng/L, and the maximum was 1.2 ng/L. Because the 30-day P_{99} of available data (0.88 ng/L) is less than the most stringent WQBEL of 1.3 ng/L, **no WQBEL for mercury is required for permit reissuance. A minimum of annual mercury monitoring is recommended for permit reissuance, consistent with other discharges to waters of the Great Lakes.**

Cadmium, Chromium, Copper, Lead, Nickel, and Zinc – **Monitoring for these metals are recommended to continue in the reissued permit to meet the requirements of their pretreatment program.**

PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for ammonia nitrogen in ch. NR 105, Wis. Adm. Code, effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. The current permit has daily maximum limits. These limits are re-evaluated at this time due to the following changes:

- Subchapter IV of ch. NR 106, Wis. Adm. Code allows limits based on available dilution instead of limits set to twice the acute criteria.
- Section NR 106.07(3), Wis. Adm. Code requires weekly and monthly average limits for municipal treatment plants.
- The maximum expected effluent pH has changed

Daily Maximum Limits based on Acute Toxicity Criteria (ATC):

Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation.

$$\text{ATC in mg/L} = [A \div (1 + 10^{(7.204 - \text{pH})})] + [B \div (1 + 10^{(\text{pH} - 7.204)})]$$

Where:

A = 0.275 and B = 39.0 for a Cold-Water Category 1 fishery, and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 1582 sample results were reported from 01/01/2016 to 04/30/2020. The maximum reported value was 7.9 s.u. (Standard pH Units).

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The effluent pH was 7.6 s.u. or less 99% of the time. The 1-day P_{99} , calculated in accordance with s. NR 106.05(5), Wis. Adm. Code, is 7.6 s.u. and the mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 7.5 s.u. Therefore, a value of 7.6 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.6 s.u. into the equation above yields an $ATC = 11.4 \text{ mg/L}$.

Potential changes to daily maximum Ammonia Nitrogen effluent limitations:

Subchapter IV of ch. NR 106, Wis. Adm. Code (effective September 1, 2016) specifies methods for the use of the 1- Q_{10} receiving water low flow to calculate daily maximum ammonia nitrogen limits if it is determined that the previous method of acute ammonia limit calculation ($2 \times ATC$) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits shall apply.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1- Q_{10} (estimated as 80 % of 7- Q_{10}) and the $2 \times ATC$ approach are shown below.

	Ammonia Nitrogen Limit mg/L
$2 \times ATC$	23
1- Q_{10}	125

The $2 \times ATC$ method yields the most stringent limits for Sheboygan. This is equivalent to the daily maximum limit in the current permit.

Weekly and Monthly Average Limits based on Chronic Toxicity Criteria (CTC)

Weekly and monthly average limits are not included in the current permit but are being evaluated here due to changes to ch. NR 106.

Weekly average and monthly average limits for ammonia nitrogen are based on chronic toxicity criteria in ch. NR 105, Wis. Adm. Code.

The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified for a Cold-Water Community is calculated by the following equation, according to subchapter IV of NR 106, Wis. Adm. Code.

$$CTC = E \times \{ [0.0676 \div (1 + 10^{(7.688 - pH)})] + [2.912 \div (1 + 10^{(pH - 7.688)})] \} \times C$$

Where:

pH = the pH (s.u.) of the receiving water,

$E = 0.854$,

$C = \text{the minimum of } 2.85 \text{ or } 1.45 \times 10^{(0.028 \times (25 - T))}$,

$T = \text{the temperature (}^{\circ}\text{C) of the receiving water}$

The 4-day criterion is equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used to derive weekly average limitations, and the 30-day criteria are used to derive monthly average limitations, both by a mass-balance using a ten-to-one dilution ratio.

Since minimal ambient data is available, the “default” basin assumed values are used for Temperature, pH and background ammonia concentrations, shown in the table below, with the resulting criteria and effluent limitations.

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		Nov – April	May – Oct
Effluent Flow	Qe (MGD)	18.39	18.39
Background Information	Ammonia (mg/L)	0.1	0.05
	Average Temperature (°C)	3	13
	Maximum Temperature (°C)	7	16
	pH (s.u.)	8.05	8.24
	Dilution factor	10	10
Criteria mg/L	4-day Chronic	5.65	3.82
	30-day Chronic	2.26	1.53
Effluent Limits mg/L	Weekly Average	61.2	41.5
	Monthly Average	23.9	16.3

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from 01/01/2016 to 04/30/2020, with those results being compared to the calculated limits to determine the need to include ammonia limits in Sheboygan's permit for the respective month ranges. That need is determined by calculating 99th upper percentile (or P₉₉) values for ammonia during each of the month ranges and comparing the daily maximum values to the daily maximum limit. Based on this comparison, limits are not needed for any season.

Ammonia Nitrogen mg/L	November – April	May – October
1-day P ₉₉	10.6	5.9
4-day P ₉₉	5.7	3.3
30-day P ₉₉	2.83	1.49
Mean*	1.65	0.76
Std	2.25	1.33
Sample size	846	104
Range	<0.078 – 12.4	<0.078 – 8.3

*Values lower than the level of detection were substituted with a zero

Where there are existing ammonia nitrogen limits in the permit, the limits must be retained regardless of reasonable potential, consistent with s. NR 106.33(1)(b), Wis. Adm. Code:

(b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

Conclusions and Recommendations:

In summary, after rounding to two significant figures, the following ammonia nitrogen limitations are recommended. The current permit has a daily maximum of 23 mg/L for November – April so this is recommended to continue in the reissued permit. No mass limitations are recommended in accordance with s. NR 106.32(5), Wis. Adm Code.

Additional limits to meet the requirements in s. NR 106.07, Wis. Adm Code, are addressed in the expression of limits section of this memo.

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BACTERIA

On May 1, 2020, revisions to chs. NR 102 and NR 210, Wis. Adm. Code became effective which replace fecal coliform limits with new *Escherichia coli* (*E. coli*) limits for protection of recreational uses. Section NR 210.06(2)(a)1, Wis. Adm. Code, includes two limits which must be included in permits for facilities which are required to disinfect:

1. The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month may not exceed 126 counts/100 mL.
2. No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 counts/100 mL.

E. coli monitoring is recommended at the same frequency that fecal coliform monitoring is required in the current permit. Because Sheboygan's permit requires weekly monitoring, the 410 counts/100 mL limit will effectively function as a daily maximum limit unless the facility performs additional monitoring. Any additional monitoring beyond what is required by the permit must also be reported on the DMR as required in the standard requirements section of the permit.

These limits are required during May through September. No changes are recommended to the current recreational period and the required disinfection season.

The current permit requires Sheboygan to disinfect year-round for protection of the public water supply, because the drinking water intake for Sheboygan Water Utilities is located approximately 3 miles from the outfall. Because the *E. coli* limits listed in NR 210.06(2)(a)1, Wis. Adm. Code, are set for protection of recreational uses and not drinking water supply, these *E. coli* limits do not necessarily need to be applied year-round. However, either *E. coli* or fecal coliform bacteria limits are needed year-round in order to ensure that there is no reduction from the current level of disinfection needed to protect the public drinking water source.

In accordance with s. NR 210.06(2)(a)2, Wis. Adm. Code, outside of the recreational season, bacteria limits may either be set equal to the previous fecal coliform limits or the listed *E. coli* limits. Therefore, the facility can select one of the two possible sets of permit limits:

- *E. coli* limits as listed above during the recreation period of May through September and a fecal coliform limit of 400 counts/100 mL as a monthly geometric mean in October through April. Any fecal coliform weekly geometric mean limit which was included in the previous permit for expression of limits purposes does not need to be included in the reissued permit.
- *E. coli* limits as listed above apply year-round.

Interim Limit

At this time, there is no effluent *E. coli* data available to determine if these limits are currently met. The permit will include a compliance schedule to meet these limits. During the compliance schedule, an interim limit applies to prevent back-sliding from the current level of disinfection during the compliance schedule period. Therefore, the current **fecal coliform limit shall be included in the reissued permit as an interim limit of 400 counts/100 mL as a monthly geometric mean**. Any weekly geometric mean limit which was included in the current permit for expression of limits purposes does not need to be included in the permit as an interim limit.

PART 5 – PHOSPHORUS

Technology Based Phosphorus Limit

Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of Total Phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit. Because Sheboygan currently has a limit of 0.9 mg/L, this limit should be included in the reissued permit. This limit remains applicable unless a more stringent water quality-based concentration limit is given.

In addition, the need for a WQBEL for phosphorus must be considered.

Water Quality-Based Effluent Limits (WQBEL)

Revisions to administrative rules regulating phosphorus took effect on December 1, 2010. These rule revisions include additions to s. NR 102.06, Wis. Adm. Code, which establish phosphorus standards for surface waters. Subchapter III of NR 217, Wis. Adm. Code, establishes procedures for determining WQBELs for phosphorus, based on the applicable standards in ch. NR 102, Wis. Adm. Code.

Section NR 102.06(5)(b) specifies that a total phosphorus criterion of 7 µg/L (0.007 mg/L) applies for the open and nearshore water of Lake Michigan. For direct discharges to Lake Michigan such as Sheboygan, s. NR 217.13(4), Wis. Adm. Code, states that the Department shall set effluent limits consistent with nearshore or whole lake models approved by the Department. In the absence of an approved model, a water quality-based phosphorus limit of 0.6 mg/L as a six-month average is considered.

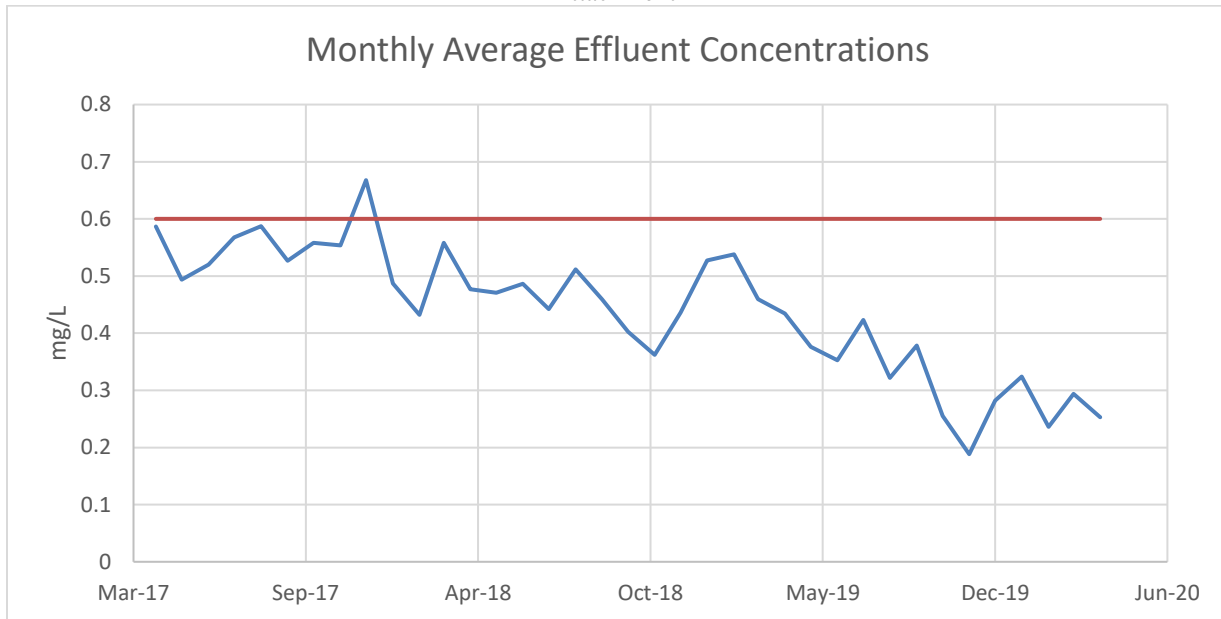
Effluent Data

The following table summarizes effluent total phosphorus monitoring data from 01/01/2016 to 04/30/2020.

	Phosphorus mg/L
1-day P ₉₉	1.2
4-day P ₉₉	0.8
30-day P ₉₉	0.57
Mean	0.47
Std	0.21
Sample size	1582
Range	0.1 – 1.9

The following graph shows the monthly average effluent concentrations from April 2017 to April 2020 compared to the WQBEL of 0.6 mg/L.

The Sheboygan effluent data demonstrates that the facility is able to meet 0.6 mg/L as a six-month average on a consistent basis. Therefore, **the WQBEL of 0.6 as a six-month average is recommended to be included in the reissued permit along with the current interim limit of 0.9 mg/L as a monthly average.**



PART 6 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b), Wis. Adm. Code, the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), Wis. Adm. Code, the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from December 2010 through December 2014.

The table below summarizes the maximum temperatures reported during monitoring from December 2010 through December 2014.

Attachment #1

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Weekly Maximum	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(°F)
JAN	54	55	NA	120
FEB	52	53	NA	120
MAR	55	57	NA	120
APR	56	57	NA	120
MAY	61	64	NA	120
JUN	67	68	NA	120
JUL	72	72	NA	120
AUG	72	73	NA	120
SEP	72	72	NA	120
OCT	67	69	NA	120
NOV	61	63	NA	120
DEC	59	60	NA	120

Reasonable Potential

Permit limits for temperature are recommended based on the procedures in s. NR 106.56, Wis. Adm. Code.

- An acute limit for temperature is recommended for each month in which the representative daily maximum effluent temperature for that month exceeds the acute WQBEL. The representative daily maximum effluent temperature is the greater of the following:
 - (a) The highest recorded representative daily maximum effluent temperature
 - (b) The projected 99th percentile of all representative daily maximum effluent temperatures
- A sub-lethal limitation for temperature is recommended for each month in which the representative weekly average effluent temperature for that month exceeds the weekly average WQBEL. The representative weekly average effluent temperature is the greater of the following:
 - (a) The highest weekly average effluent temperature for the month.
 - (b) The projected 99th percentile of all representative weekly average effluent temperatures for the month.

Based on the available effluent data no effluent limits or monitoring are recommended for temperature. The complete thermal table used for calculation is in Attachment #3.

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET

Attachment #1

limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the WET Program Guidance Document (October 29, 2019).

- Acute tests predict the concentration that causes lethality of aquatic organisms during a 48 to 96-hour exposure. To assure that a discharge is not acutely toxic to organisms in the receiving water, WET tests must produce a statistically valid LC₅₀ (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09 (2) (b), Wis. Adm Code.
- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. To assure that a discharge is not chronically toxic to organisms in the receiving water, WET tests must produce a statistically valid IC₂₅ (Inhibition Concentration) greater than the instream waste concentration (IWC), according to s. NR 106.09 (3) (b), Wis. Adm Code. The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent). The IWC of 9% shown in the WET Checklist summary below was calculated according to the following equation, as specified in s. NR 106.03(6), Wis. Adm Code:

The IWC is 9% based on dilution of 10 parts lake water to 1-part effluent, as specified in s. NR 106.06 (4) (b) 2, Wis. Adm. Code, or a factor of 1 in 11 to calculate the IWC.

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests, unless the use of different dilution water is approved by the Department prior to use. The primary control water must be specified in the WPDES permit.
- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), receiving water must be used as the dilution water and primary control in chronic WET tests, unless the use of different dilution water is approved by the Department prior to use. The dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the receiving water location, upstream and out of the influence of the mixing zone and any other known discharge. The specific receiving water location must be specified in the WPDES permit.
- Shown below is a tabulation of all available WET data for Outfall 001. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data, as specified in s. NR 106.08 (3), Wis. Adm Code. Data which is not believed to be representative of the discharge was not included in reasonable potential calculations. Significant changes were made to WET test methods in 2004 and these changes were assumed to be fully implemented by certified labs by no later than June 2005, so data after that date is not included in the table below. The table below differentiates between tests used and not used when making WET determinations.

WET Data History

Date Test Initiated	Acute Results				Chronic Results				Footnotes or Comments
	LC ₅₀ % (% survival in 100% effluent)				IC ₂₅ %				
	<i>C. dubia</i>	Fathead minnow	Pass or Fail?	Used in RP?	<i>C. dubia</i>	Fathead Minnow	Pass or Fail?	Use in RP?	
03/28/2006	>100	>100	Pass	Yes	32.06	>100	Pass	Yes	
12/04/2007	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
09/09/2008	>100	>100	Pass	No	>100	>100	Pass	No	1
05/12/2009	>100	>100	Pass	No	>100	>100	Pass	No	1

Attachment #1

Date Test Initiated	Acute Results LC ₅₀ % (% survival in 100% effluent)				Chronic Results IC ₂₅ %				Footnotes or Comments
	<i>C. dubia</i>	Fathead minnow	Pass or Fail?	Used in RP?	<i>C. dubia</i>	Fathead Minnow	Pass or Fail?	Use in RP?	
03/18/2010	>100	>100	Pass	No	>100	>100	Pass	No	1
10/23/2012	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
07/30/2013	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
05/20/2014	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
02/03/2015	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
07/26/2016	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
02/14/2017	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
05/15/2018	>100	>100	Pass	Yes	>100	51	Pass	Yes	
10/08/2019	>100	>100	Pass	Yes	>100	>100	Pass	Yes	

Footnotes:

1. *Tests done by S-F Analytical, July 2008 – March 2011.* The DNR has reason to believe that WET tests completed by SF Analytical Labs from July 2008 through March 31, 2011 were not performed using proper test methods. Therefore, WET data from this lab during this period has been disqualified and was not included in the analysis.
- According to s. NR 106.08, Wis. Adm. Code, WET reasonable potential is determined by multiplying the highest toxicity value that has been measured in the effluent by a safety factor, to predict the likelihood (95% probability) of toxicity occurring in the effluent above the applicable WET limit. The safety factor used in the equation changes based on the number of toxicity detects in the dataset. The fewer detects present, the higher the safety factor, because there is more uncertainty surrounding the predicted value. **WET limits must be given, according to s. NR 106.08(6), Wis. Adm. Code, whenever the applicable Reasonable Potential equation results in a value greater than 1.0.**

$$\text{Acute Reasonable Potential} = [(TUa \text{ effluent}) (B)(AMZ)]$$

$$\text{Chronic Reasonable Potential} = [(TUc \text{ effluent}) (B)(IWC)]$$

According to s. NR 106.08(6)(d), Wis. Adm. Code, TUa and TUc effluent values are equal to zero whenever toxicity is not detected (i.e. when the LC₅₀, IC₂₅ or IC₅₀ ≥ 100%).

Acute Reasonable Potential = 0 < 1.0, reasonable potential is not shown, and a limit is not required.

$$\text{Chronic Reasonable Potential} = [(TUc \text{ effluent}) (B)(IWC)]$$

TUc (maximum) 100/IC ₂₅	B (multiplication factor from s. NR 106.08(5)(c), Wis. Adm. Code, Table 4)	IWC
100/32.06 = 3.12	3.8 Based on 2 detects	9%

$$[(TUc \text{ effluent}) (B)(IWC)] = 1.07 > 1.0$$

Therefore, reasonable potential is shown for chronic WET limits using the procedures in s. NR 106.08(6) and representative data from 03/28/2006 to 10/08/2019.

Expression of WET limits

Chronic WET limit = $100/9 \text{ TU}_c = 11 \text{ TU}_c$ expressed as a monthly average

The WET Checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other related permit conditions. The Checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code. The Checklist steps the user through a series of questions, assesses points based on the potential for effluent toxicity, and suggests monitoring frequencies based on points accumulated during the Checklist analysis. As toxicity potential increases, more points accumulate, and more monitoring is recommended to ensure that toxicity is not occurring. A summary of the WET Checklist analysis completed for this permittee is shown in the table below. Staff recommendations based on best professional judgment are provided below the summary table. For guidance related to reasonable potential and the WET Checklist, see Chapter 1.3 of the WET Guidance Document: <http://dnr.wi.gov/topic/wastewater/WETguidance.html>.

WET Checklist Summary

	Acute	Chronic
AMZ/IWC	Not Applicable. 0 Points	IWC = 9 %. 0 Points
Historical Data	10 tests used to calculate RP. No tests failed. 0 Points	10 tests used to calculate RP. No tests failed. 0 Points
Effluent Variability	Little variability, no violations or upsets, consistent WWTF operations. 0 Points	Same as Acute. 0 Points
Receiving Water Classification	Cold water community 5 Points	Same as Acute. 5 Points
Chemical-Specific Data	Reasonable potential for limits for no substances based on ATC; ammonia, arsenic, cadmium, chloride, chromium, copper, lead, mercury, nickel, and zinc detected. Additional Compounds of Concern: chloroform, thallium, and 2,4,6-trichlorophenol 5 Points	Reasonable potential for limits for no substances based on CTC; ammonia, arsenic, cadmium, chloride, chromium, copper, lead, mercury, nickel, and zinc detected. Additional Compounds of Concern: chloroform, thallium, and 2,4,6-trichlorophenol 5 Points
Additives	1 Biocides and 2 Water Quality Conditioners added. P treatment chemical other than Ferric Chloride (FeCl), Ferrous Sulfate (FeSO ₄), or alum used: No 5 Points	All additives used more than once per 4 days. 5 Points
Discharge Category	8 Industrial Contributors. 12 Points	Same as Acute. 12 Points
Wastewater Treatment	Secondary treatment 0 Points	Same as Acute. 0 Points
Downstream Impacts	No impacts known 0 Points	Same as Acute. 0 Points
Total Checklist Points:	27 Points	27 Points

	Acute	Chronic
Recommended Monitoring Frequency (from Checklist):	1x yearly	1x yearly
Limit Required?	No	Yes Limit = 11 TU _c
TRE Recommended? (from Checklist)	No	No

- After consideration of the guidance provided in the Department's WET Program Guidance Document (2019) and other information described above 1x/yearly acute and 1x/yearly chronic WET tests are recommended in the reissued permit. Tests should be done in rotating quarters to collect seasonal information about this discharge. WET testing should continue after the permit expiration date (until the permit is reissued).
- According to the requirements specified in s. NR 106.08, Wis. Adm. Code, a chronic WET limit is required. The chronic WET limit shall be expressed as 11 TU_c as a monthly average in the effluent limits table of the permit.
- A minimum of annual chronic monitoring is required because a chronic WET limit is required. Federal regulations in 40 CFR Part 122.44(i) require that monitoring occur at least once per year when a limit is present.
- A minimum of annual acute and chronic monitoring is recommended because Sheboygan is a major municipal discharger with a design flow greater than 1.0 MGD. Federal regulations at 40 CFR Part 122.21(j) require at least 4 acute and chronic WET tests with each permit application on samples collected since the previous reissuance. Therefore, annual monitoring is recommended in the permit term, so that data will be available for the next permit application.

PART 8 – EXPRESSION OF LIMITS

Revisions to chs. NR 106 and 205, Wis. Adm. Code align Wisconsin's water quality-based effluent limits with 40 CFR 122.45(d), which requires WPDES permits contain the following concentration limits, whenever practicable and necessary to protect water quality:

- Weekly average and monthly average limitations for continuous discharges subject to ch. NR 210.
- Daily maximum and monthly average limitations for all other discharges.

Sheboygan is a municipal treatment facility and is therefore subject to weekly average and monthly average limitations whenever limitations are determined to be necessary.

This evaluation provides additional limitations necessary to comply with the expression of limits in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code. Pollutants already compliant with these rules or that have an approved impracticability demonstration, are excluded from this evaluation including water-quality based effluent limitations for phosphorus, temperature, and pH, among other parameters. Mass limitations are not subject to the limit expression requirements if concentrations limits are given.

Method for calculation:

The methods for calculating limitations for continuous discharges subject to ch. NR 210 to conform to 40 CFR 122.45(d) are specified in s. NR 106.07(3), Wis. Adm. Code, and are as follows:

Attachment #2

1. Whenever a daily maximum limitation is determined necessary to protect water quality, a weekly and monthly average limitation shall also be included in the permit and set equal to the daily maximum limit unless a more restrictive limit is already determined necessary to protect water quality.
 - Chlorine, Total Residual – A daily maximum limit of 38 µg/L is necessary, so a weekly and a monthly average limit is needed to be included in the reissued permit. The calculated weekly limit from Part 2 of this memo is 80 µg/L. Because this is less restrictive than the daily maximum limit, the weekly and monthly limits shall be equal to the daily maximum limit.
 - Ammonia Nitrogen – A daily maximum limit of 23 mg/L is necessary for November – April, so a weekly and a monthly average limit is needed to be included in the reissued permit. The calculated weekly and monthly average limits in Part 3 of this memo are less restrictive than 23 mg/L, so the weekly and monthly limits shall be equal to the daily maximum limit.
2. Whenever a weekly average limitation is determined necessary to protect water quality, a monthly average limitation shall also be included in the permit and set equal to the weekly average limit unless a more restrictive limit is already determined necessary to protect water quality.
3. Whenever a monthly average limitation is determined necessary to protect water quality, a weekly average limit shall be calculated using the following procedure and included in the permit unless a more restrictive limit is already determined necessary to protect water quality:

$$\text{Weekly Average Limitation} = (\text{Monthly Average Limitation} \times \text{MF})$$

Where:

MF= Multiplication factor as defined in Table 1

CV= coefficient of variation (CV) as calculated in s. NR 106.07(5m)

n= the number of samples per month required in the permit

s. NR 106.07 (3) (e) 4. Table 1 — Multiplication Factor (for CV = 0.6)

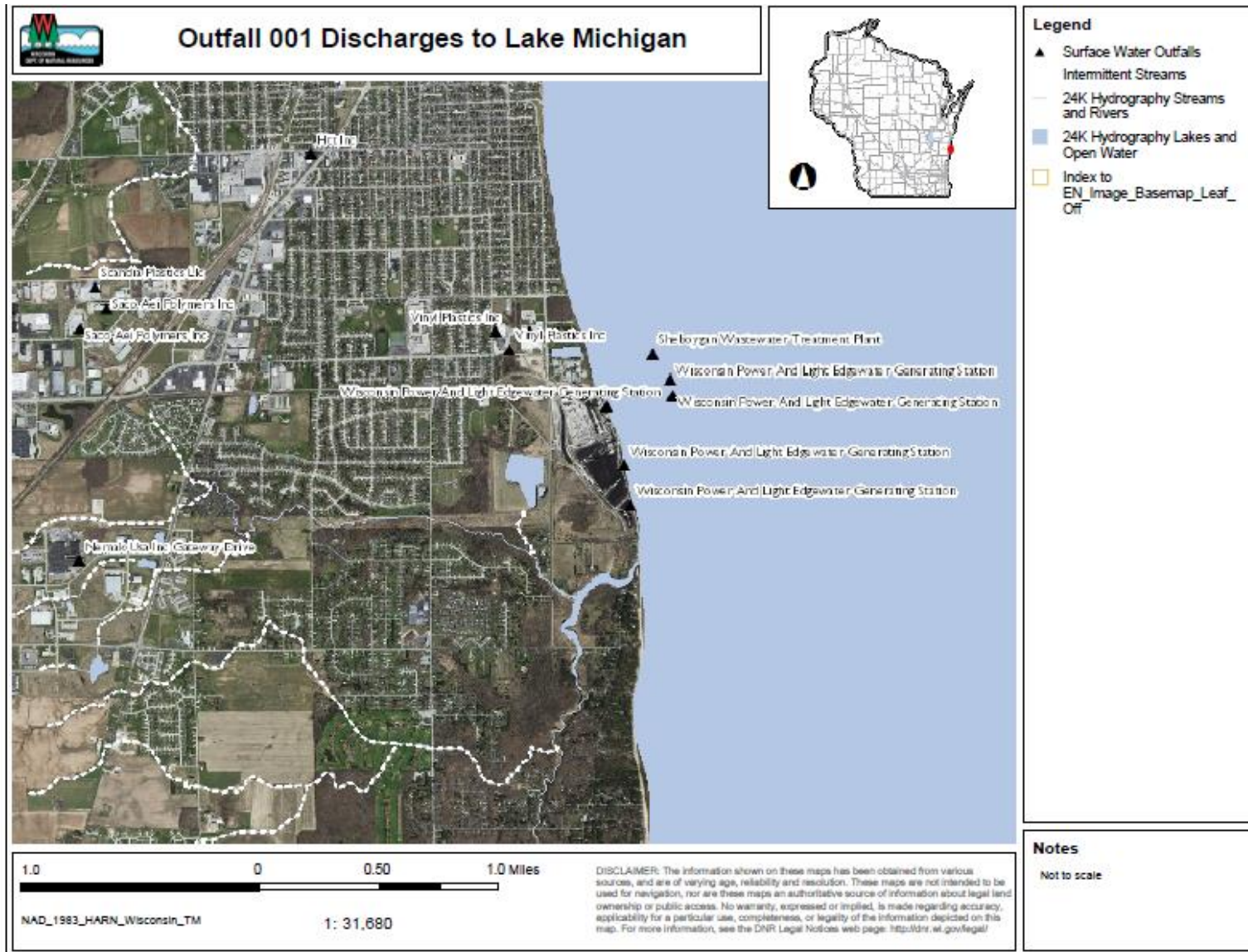
CV	n=1	n=2	n=3	n=4	n=8	n=12	n=16	n=20	n=24	n=30
0.6	1.00	1.31	1.51	1.64	1.95	2.12	2.23	2.30	2.36	2.43

Note: This methodology is based on the *Technical Support Document for Water Quality-based Toxics Control* (March 1991). PB91-127415.

Summary of Additional Limitations:

In conclusion, the following additional limitations are required to comply with ss. NR 106.07 and NR 205.065(7) Expression of Limits.

Parameter	Daily Maximum	Weekly Average	Monthly Average
Chlorine, Total Residual	38 µg/L	38 µg/L	38 µg/L
Ammonia Nitrogen November – April	23 mg/L	23 mg/L	23 mg/L



Temperature limits for receiving waters without unidirectional flow

(calculation using default ambient temperature data)

Facility: Sheboygan Wastewater Treatment
Outfall(s): 001
Date Prepared: 06/09/2020
Design Flow (Qe): 18.39 MGD

Data Range
Start: 12/01/10
End: 12/31/14

Lake Type: Lake Michigan waters - Sout
Discharge Type: Great Lakes off-shore discharge

Maximum area of mixing zone allowed
(coefficient "A"): 3,141,593 ft²

Month	Water Quality Criteria			Representative Highest Effluent Flow Rate (Qe)					Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Ta (default)	Sub- Lethal WQC	Acute WQC	7-day Rolling Average (Qesl)	Daily Maximum Flow Rate (Qea)	B	e ^{-a} (for SL- WQBEL)	e ^{-a} (for A- WQBEL)	Weekly Average	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(MGD)	(MGD)				(°F)	(°F)	(°F)	(°F)
JAN	35	43	69	11.92	16.51	0.405	0.026	0.072	54	55	NA	120
FEB	34	46	69	10.80	14.109	0.405	0.018	0.046	52	53	NA	120
MAR	37	52	70	19.54	28.528	0.405	0.108	0.218	55	57	NA	120
APR	43	59	70	27.44	41.811	0.405	0.205	0.354	56	57	NA	119
MAY	48	65	72	18.74	22.783	0.405	0.098	0.148	61	64	NA	120
JUN	54	70	73	20.17	32.100	0.405	0.116	0.258	67	68	NA	120
JUL	59	71	74	14.12	19.378	0.405	0.046	0.106	72	72	NA	120
AUG	63	70	76	10.74	14.072	0.555	0.008	0.025	72	73	NA	120
SEP	60	64	74	9.20	10.696	0.555	0.004	0.008	72	72	NA	120
OCT	53	57	73	13.21	18.608	0.405	0.037	0.097	67	69	NA	120
NOV	45	49	71	11.65	16.677	0.405	0.024	0.074	61	63	NA	120
DEC	38	44	70	14.55	21.984	0.405	0.050	0.138	59	60	NA	120